Fecal coliform TMDL Developed for the West Fork Big Blue River Basin (Sub-basin BB3)

(Modified 2/15/01)

Waterbody Summary

Waterbody Name	**West Fork Big Blue River**
Title 117 Sub-basin /Segment Number	**BB3/BB3-10000**
Segment Length	**32 miles (approximate)**
Major River Basin	**Kansas**
Minor River Basin	**Big Blue**
Hydrologic Unit Code (HUC)	**10270203**
Designated Uses	**Aquatic Life-Warmwater A, Recreation, Agriculture A, Aesthetics**
Key Aquatic Species	**Channel Catfish, Flathead Catfish**
Major Tributaries	**Beaver Creek, School Creek**

Introduction/Background

The West Fork Big Blue River has been assigned the primary contact recreation beneficial use. Waterbodies are assigned this use based upon suitable stream depth, flow, the presence of sand bars, bathing areas, and public access as well as other factors. Primary contact recreation refers to recreational activities where sensitive body parts (eyes, ears, mouth, etc.) come into prolonged or intimate contact with a waterbody. Title 117 - Nebraska Surface Water Quality Standards (Title 117)[3] contains the criteria designed to protect this beneficial use. The language and criteria are as follows:

Bacteria of the Fecal coliform group shall not exceed a geometric mean of 200/100 ml, nor exceed 400/100 ml, in more than 10% of the samples. These criteria are based upon a minimum of 5 samples taken within a 30-day period. This does not preclude fecal coliform limitations based on effluent guidelines.

These criteria apply during the recreational period of May 1 through September 30.

Problem Characterization

Waterbodies assigned the recreational beneficial use are assessed for the level of use attainment using available fecal coliform data. In order for a waterbody to be deemed impaired and placed on a Section 303(d) list, the data must be less than 5 years old. If the data is of acceptable age the following criteria are used to define impairment.

- The geometric mean of the samples collected exceeds 200/100 ml, or
- >10% of all samples exceed 400/100ml

As part of the rotating basin monitoring program, samples were obtained from the West Fork Big Blue River near Dorchester (Figure 1). The site was chosen to represent segment BB3-10000. Samples were collected during the designated recreation period for 1997. The sampling program was developed and carried out in order to obtain the minimum data necessary to make a direct comparison to Title 117 criteria. A summary of the collected data is presented in the Table 1. Based upon those samples, the waterbody was determined to be "not supporting" the assigned beneficial use and for this reason the waterbody was listed on the 1998 Nebraska Section 303(d) List. This TMDL has been developed to fulfill the requirements of the Clean Water Act – Section 303(d).

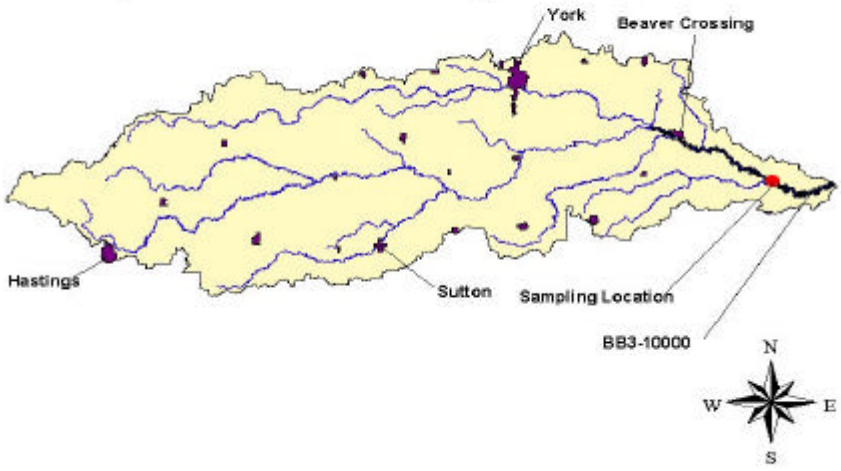
Table 1. Fecal coliform data collected from Segment BB3-10000 during 1997.

Month	Number of Samples	Geometric Mean	>200/100 ml?	Number >400 /100ml	Beneficial Use Assessment
May	5	329	Yes	2	
June	5	3,900	Yes	5	
July	5	6,660	Yes	5	
August	5	2,563	Yes	5	
September	5	432	Yes	1	
Season	25	1,567	100% exceeds	18(72%)	Not Supporting

TMDL Endpoint

The endpoint for this TMDL will be the Title 117 specified water quality criteria established for the protection of primary contact recreation as described above. In the future additional data will be collected (see ***Monitoring*** section below) and the segment will be removed from the Section 303(d) list when the waterbody is assessed as "full support" based on the applicable assessment criteria.

Figure 1. 1997 Sampling Location



Basin Description

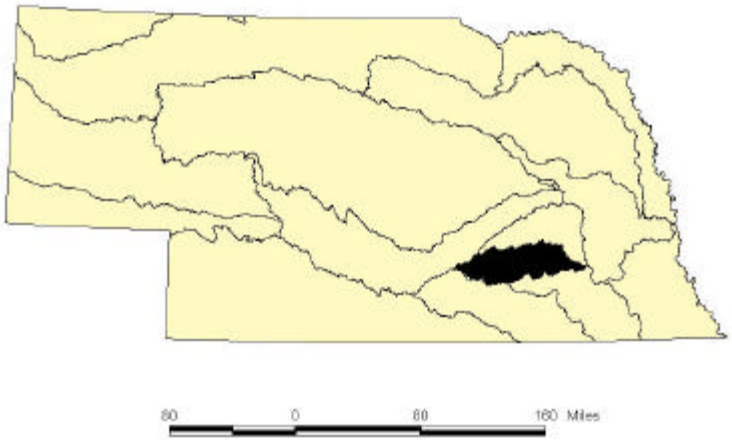
The West Fork Big Blue River watershed lies in southeast/south central Nebraska and the drainage area at the mouth is approximately 1,314 mi^2 (Figure 2). Agriculture dominates the land use. Other land uses are urban areas, streams, wetlands and wooded areas. Corn, soybean and sorghum are the major crops grown in the watershed with lesser amounts of wheat and alfalfa. Irrigation plays an important role in row crop production, which is evident by the 1,071irrigation wells registered in the Upper Big Blue Natural Resource District[6]. Also, areas of native or cultivated grasses are hayed or pastured. Another major agricultural activity is the confined feeding and finishing of livestock.

The larger municipal areas that lie partially or wholly in the watershed include Hastings (pop. 23,045), York (pop. 7,723)[2] and Aurora (pop. 4,225)[6]. Many smaller communities occur throughout the watershed such as, Beaver Crossing, Bradshaw, Doniphan, Dorchester, Exeter, Fairmont, Grafton, Hampton, Harvard, Henderson, Giltner, McCool Junction, Sutton, Utica and Waco.

On the average the watershed receives approximately 30 inches of precipitation annually with the majority falling as rain during the months of April through August. The topography is generally flat on the western and central portion of the waterbody and on the eastern end, the flat plain gives way to a dissected table land[5].

Due to the relatively impermeable loess soils of the watershed, little infiltration is allowed into the ground and the baseflow of many of the tributaries is low while run-off can be large and rapid[5]. Therefore, the duration and frequency of precipitation events often dictate stream flows in the watershed although withdrawals and returns from irrigation may affect flow volume.

Figure 2. Location of the West Fork Big Blue River Basin



Probable Sources

Municipal WWTFs – The majority of the municipalities that occur in the watershed have a central wastewater treatment facility (WWTF). The facility types range from large facilities that receive a combination of industrial and domestic wastewater to simple lagoon systems. The technology utilized may result in a continuous discharge or a periodic discharge during a specified period. Also, the presence of a centralized facility does not equate to a discharge to the watershed. Several facilities have sufficient capacity to retain the wastewater with depletions coming from infiltration and evaporation. As well, there are four villages that use either individual or some form of centralized septic systems. Table 2 lists the facilities residing in the watershed.

Table 2. Municipalities in the West Fork Big Blue Watershed

Municipality	Treatment Type	Median April-October Flow (cfs)	Discharge During Recreation Season?	Current Fecal coliform Limits?
Beaver Crossing	Controlled Discharge Lagoon	2.17	Possible	Yes
Bradshaw	Controlled Discharge Lagoon	3.13	Possible	No
Cordova	Complete Retention Lagoon		No	No
Exeter	Controlled Discharge Lagoon	0.12	Possible	No
Fairmont	Activated Sludge	0.23	Yes	No
Giltner	Complete Retention Lagoon		No	No
Grafton	Controlled Discharge Lagoon	0.02	Possible	No
Hampton	Lagoon with Land Application		No	No
Harvard	Complete Retention Lagoon		No	No
Hastings	Rotating Biological Contactor	6.43	Yes	No
Henderson	Complete Retention Lagoon		No	No
Lushton	Septic Systems		No	No
McCool Junction	Lagoon with Rapid Infiltration		No	No
Prosser	Septic Systems		No	No
Saronville	Septic Systems		No	No
Stockham	Septic Systems		No	No
Sutton	Activated Sludge	0.23	Yes	No
Trumbull	Complete Retention Lagoon		No	No
Utica	Controlled Discharge Lagoon	0.15	Yes	No
Waco	Activated Sludge	0.04	Yes	No
York	Trickling Filter	2.54	Yes	No

As well as the contribution from the discharge pipe the mechanical facilities (activated sludge, trickling filter, sequencing batch reactors and rotating biological contactor) generate biosolids in the wastewater treatment process. The most common disposal method for the biosolids is land application for the purpose of beneficial reuse. During periods of run-off or improper application site management, contributions of fecal coliform can occur.

Individual Treatment Facilities – Rural residents or commercial facilities that lie outside of an urban area will likely utilize a septic system or lagoon for the treatment of wastewater. By design, these facilities do not discharge. However, improper operation, improper maintenance, system failure, extreme precipitation events or periods of groundwater recharge can contribute fecal coliform to surface waters.

Industrial WWTFs – Industrial facilities that have sanitary wastewater treatment facilities or are considered meat processors (including rendering facilities) could be a source of fecal coliform. At this time, there have not been any NPDES permits issued to an industrial facility that would contribute fecal coliform bacteria within the watershed.

Urban Run-off – Failing septic systems, illegal discharges (portable toilets, recreational vehicles, etc.) pet and other animal waste can be a source of fecal bacteria during precipitation events. Cross connections (sanitary/storm sewer) can also be a source of bacteria.

Agricultural Contributions – Nonpoint source discharges from agricultural lands can be a significant source of fecal coliform bacteria. In Nebraska, Confined Animal Feeding Operations (CAFO) that are comprised of three hundred (300) animal units or larger, or threaten the quality of the waters of the state are required to construct and maintain waste control facilities. However, these facilities are only designed to contain a 25-year 24-hour storm event. Smaller facilities are not required to have control facilities and open lot and other facilities can discharge during precipitation events. Other animal feeding operations such as swine "farrow to finish", dairy operations and some cattle feeding operations can create a liquid waste that can be applied using conventional irrigation equipment. Improper site or equipment maintenance can lead to discharges. Because these are fluid discharges, precipitation is not necessarily needed for delivery to a waterbody.

In addition to CAFO sources, those livestock operations not defined as CAFOs, such as grazing activities and manure and other land application activities can contribute fecal coliform bacteria during precipitation events.

The Department will work in conjunction with the Natural Resource District to identify specific CAFO's or other agriculture sources of fecal coliform.

Natural Sources – Wildlife can contribute fecal coliform to a waterbody either directly or indirectly via run-off events.

Data Quality Assessment – Outliers

Figure 3 provides monthly box plots of the fecal coliform data collected from segment BB3-10000 during 1997. The long whisker on the box plot for the month of July indicates an extreme value that may be statistical outlier, is present in the data set. The results of the 7/1/97 analysis yielded a 76,000/100ml value with the flow volume being 274 cfs. In comparison, other samples with lower fecal values obtained during higher flows do exist. The tool used for the outlier evaluation was the Discordance Test (found in EPA's Data Quality Evaluation Statistical Toolbox (DataQUEST) – QA 96 Version[1]). The conclusions of the Discordance Test option were that the extreme value of 76,000 is a statistical outlier at a 5% significance level. The value may be an actual representation of the conditions at the time of the sample or may reflect sampling variability, errors in analysis or data transcription errors. For the purposes of source identification and the TMDL, the data will be considered an outlier and the analysis will not include this data point. Figure 4 illustrates the monthly box plots for the 1997 data minus the 76,000/100 ml value.

Source Identification

A generally accepted hypothesis is that if stream flow and increased fecal coliform count are positively related (i.e. increasing stream flow associated with increasing fecal coliform counts) then the source of the coliform is likely nonpoint source driven. If a trend of decreasing stream flow and increasing fecal coliform count is observed then point sources are likely responsible.

The 1997 data was collected on a fixed frequency basis with the goal being to obtain five samples per month to compare back to Title 117 criteria and make a beneficial use assessment. A USGS water quantity measurement gage was located at the bacteria sampling site, so daily flow volume was obtained. With the available mean daily flow (calculated for the gage and reported by USGS), the individual fecal samples can be plotted against the mean flow from the day of sampling.

Figure 3. West Fork Big Blue River @ Dorchester-1997
Fecal c. Distribution by Month

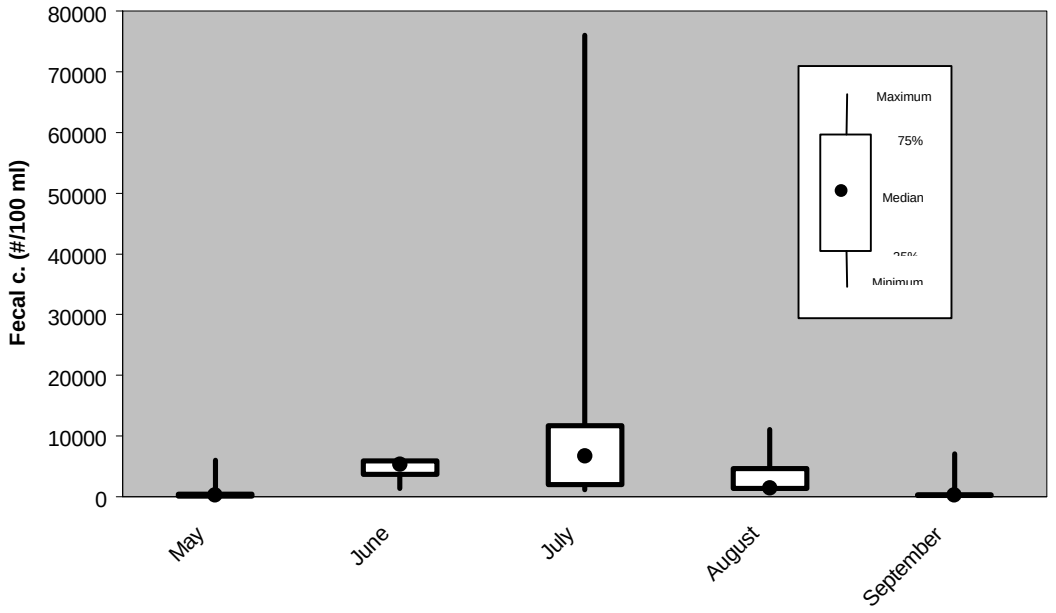
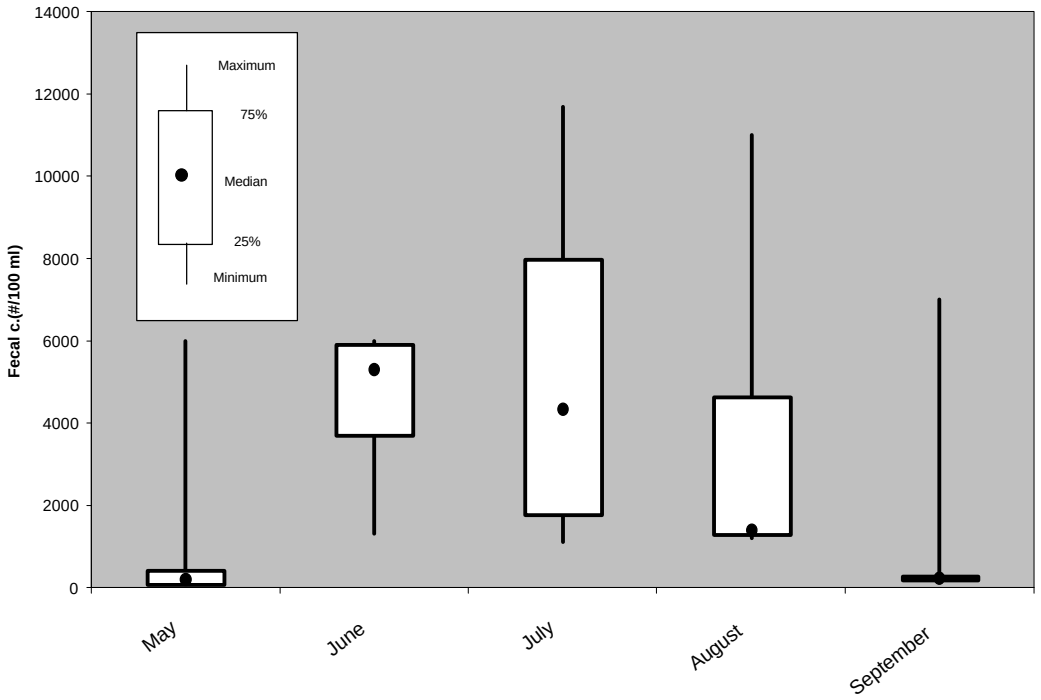


Figure 4. West Fork Big Blue River @ Dorchester-1997
Fecal c. Distribution by Month (outlier removed)



The result of the analysis yields a correlation of determination (r^2) of 0.49 and a correlation coefficient (r) of 0.7 (Figure 5). Additionally, using a SAS analysis of variance, the regression was determined to be statistically significant at an alpha level <0.01. While the data indicates a strong relationship between the monitored fecal coliform levels and stream flow, the monitoring plan was designed to obtain 5 samples regardless of stream flow conditions, and therefore may have "missed" the concentrations which are indicative of extreme (high or low) flow events. Future monitoring will target sampling under extreme flow events that may increase the observed correlation between stream flow and measured fecal coliform levels. Also, Figure 6 shows that stream flow volume exhibited a delayed response to precipitation events, as measured at 3 locations (Friend, Hastings and York) in the watershed. The graph shows that the sampling may not have captured the impact of the precipitation events. This information will also be taken into account when developing future monitoring schemes.

Figure 5. West Fork Big Blue River Stream Flow vs. Fecal coliform

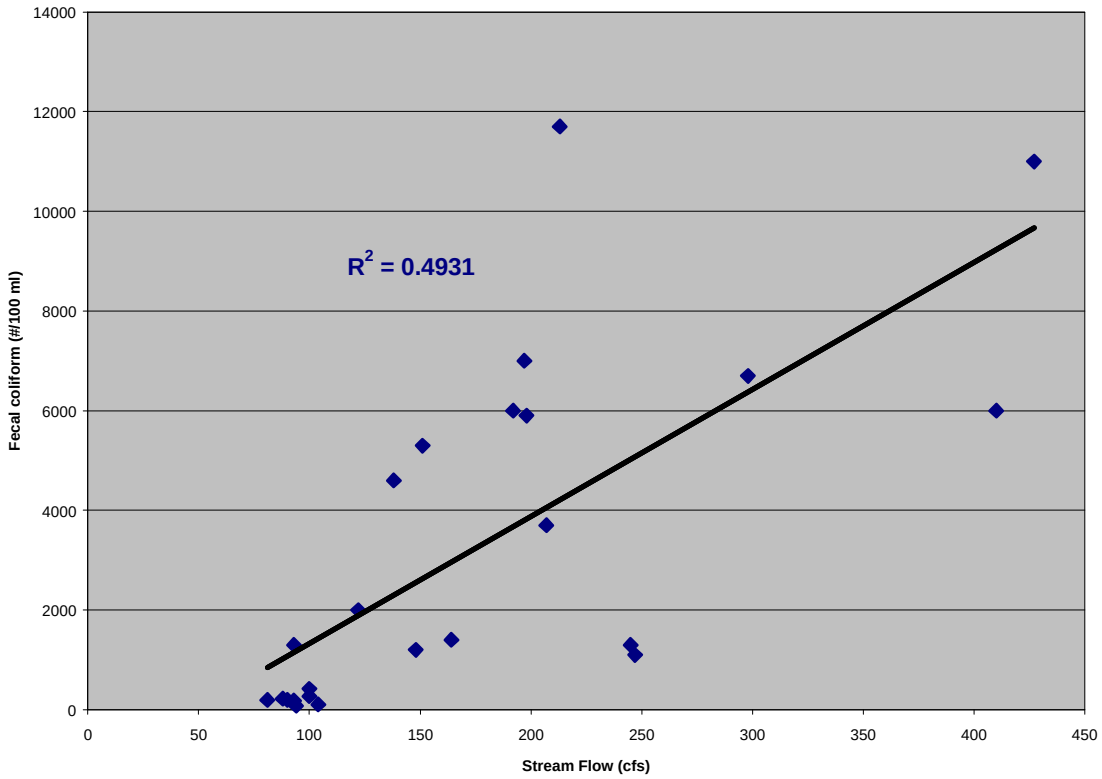
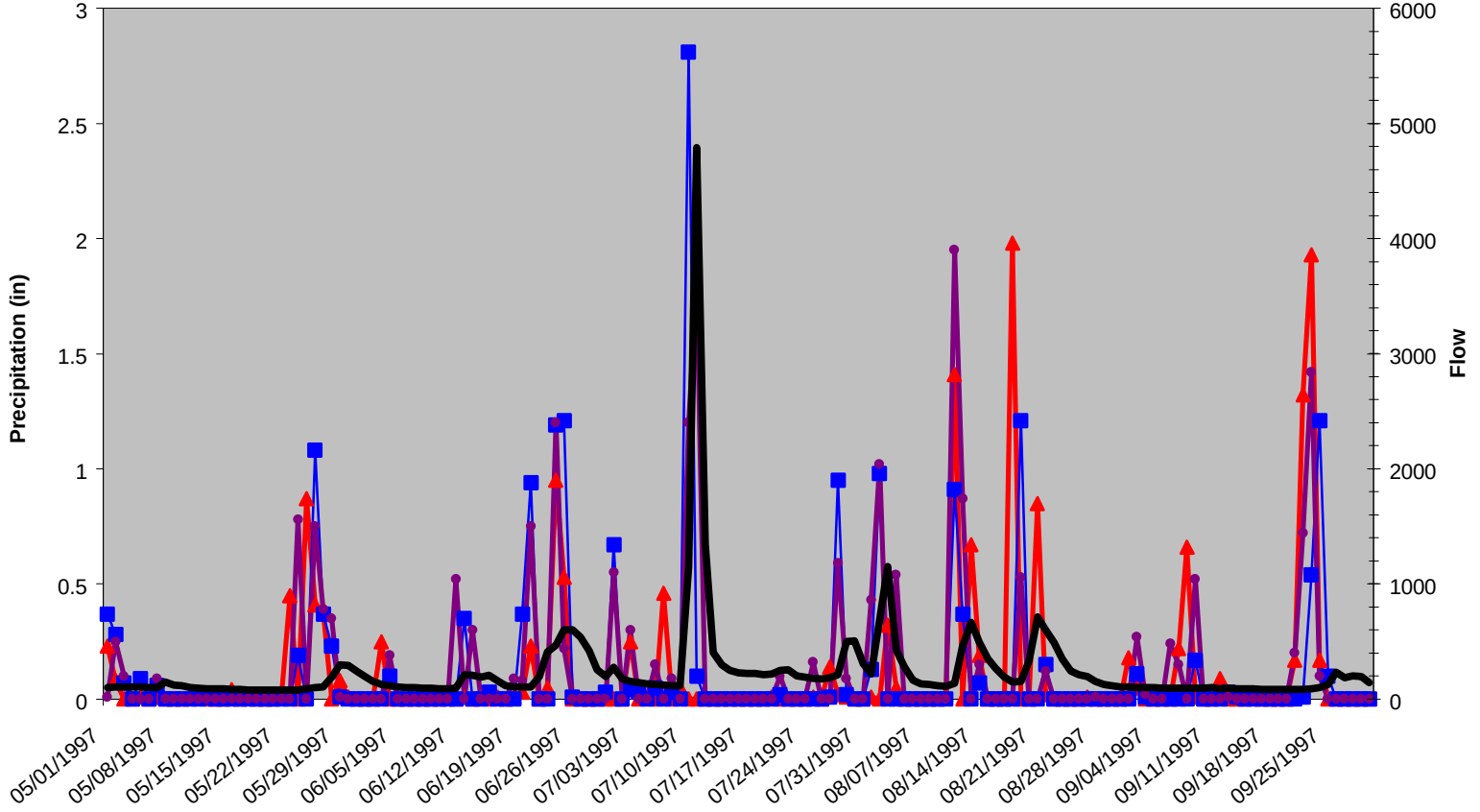


Figure 6. West Fork Big Blue Basin
Precipitation vs Flow @ Dorchester

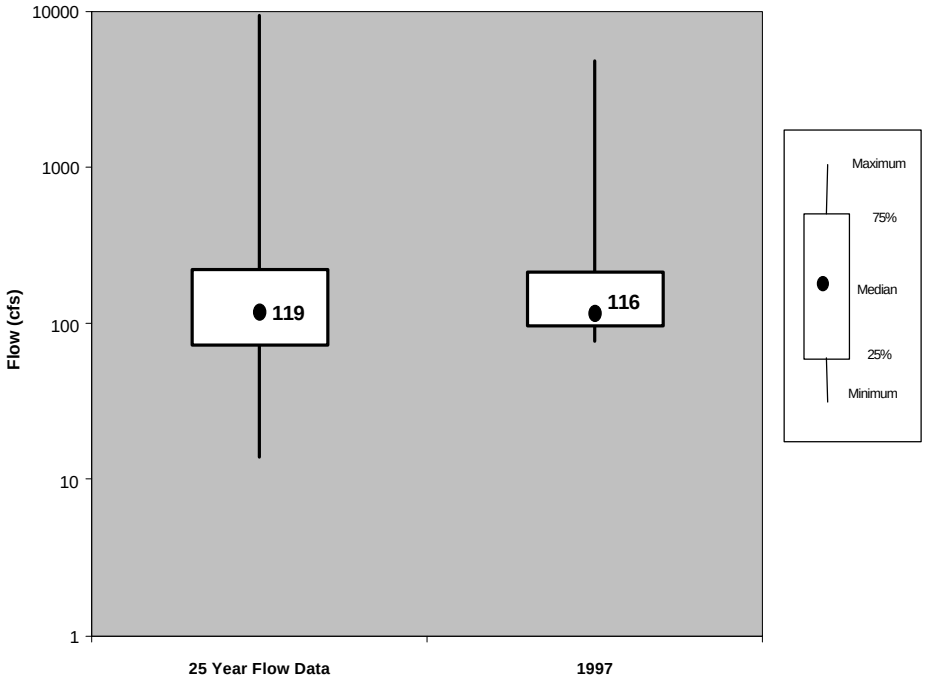


The purpose of this evaluation is not to discount the impacts point source discharges may have on segment BB3-10000, but rather to show that during 1997 nonpoint source contributions appear to have been the dominant influence on fecal coliform concentrations.

Loading Capacity

By regulation, a TMDL requires loading capacity value for the pollutant of concern. In the case of fecal coliform, a "load" (flow rate x concentration x time) could be calculated, but may not be the best way to approach this non-conservative parameter. Therefore, for the purposes of this TMDL, a loading capacity will not be "calculated" but by default will be the water quality standard. The TMDL endpoint (Title 117 criteria) will be met through a targeted reduction from the 1997 sampling concentrations. This approach was pursued based on the conclusion that 1997 was a representative year for flow (Figure 7) and any reduction actions should be applicable during future years.

Figure 7. Comparison of 1997 Flow to 25-year Period of Record
May 1- Sept. 30 (Logarithmic)



TMDL Allocations/Reductions – Wasteload Allocations

Title 117 – states "These standards, except water quality criteria associated with aesthetics and recreation will not apply within mixing zones…". The interpretation of this language is that mixings zones are not allowed in order to meet fecal coliform bacteria criteria and thus the criteria must be met at the end of the pipe.

In order to meet the TMDL endpoint, any point source which discharges directly to Segment BB3-10000 will be required to meet a monthly geometric mean of 200/100 ml and not exceed 400/100 ml in more than 10% of the samples obtained in one month.

The Nebraska Department of Environmental Quality's Disinfection Policy[4] requires that facilities discharging indirectly to a protected water (recreationally designated or high public access) be evaluated on a case-by-case basis as to the need for NPDES permit limits for fecal coliform bacteria. Screening procedures established by this policy will be followed to determine if a facility requires NPDES limitations. Currently, the Department's Municipal and Industrial Section – Permitting Unit (formerly Permits and Compliance Section) is following this policy when drafting and issuing NPDES permits.

TMDL Allocations/Reductions – Load Allocations

The Load Allocation for the TMDL will be the water quality criteria identified in Title 117. The conclusion of the above data assessment is that nonpoint source contributions were the primary cause for the impaired status of BB3-10000, during 1997. Since the calculation of a loading capacity for fecal coliform was not deemed appropriate, in order to meet the "load allocation" for this TMDL a 95% reduction of fecal coliform concentrations which are >400/100 ml is needed. Only those fecal coliform values of greater than 400 were chosen because those values <400 appear to be associated with "baseflow" and not driving the water quality criteria "violations". As shown by Table 3, a 95% reduction will result in the attainment of the beneficial use as defined by the fecal coliform criteria in Title 117. Thus the implementation of practices will be targeted at reducing the measured values of fecal coliform bacteria by 95%.

Table 3. 95% Reduction of the 1997 Measured Values.

Actual Measurements	*Reduced*	*Actual Geo-mean*	*Reduced Geo-mean*	*Actual Percentage >400/100 ml*	*Reduced Percentage >400/100ml*
100	100				
420	21				
80	80				
190	190				
6,000	300				
5,300	265				
1,300	65				
3,700	185				
6,000	300				
5,900	295				
2,000	100				
6,700	335				
1,100	55				
11,700	585				
11,000	550				
1,400	70				
4,600	230				
1,200	60				
1,300	65				
270	270				
180	180				
220	220				
200	200				
7,000	350	1332.7	159.7	70.8	8.3

Margin of Safety

TMDLs must include a margin of safety and for this TMDL the margin of safety will be:

The water quality criteria applicable for the protection of the recreation beneficial use is based upon compliance with both a geometric mean (200 /100 ml) and restrictions on the percentage of the samples that can exceed 400 /100 ml (10%). As stated, a 95% reduction from the 1997 values will result in attainment of both levels of the water quality criteria. In achieving the water quality criteria, the needed reduction will result in a geometric mean of 160 #/100ml and 8.3% of the samples exceeding 400 #/100 ml.

The difference between the reduced geometric mean and the water quality criteria is 40 #/100 ml or 20% and the difference between the percentage of values that exceed and the water quality criteria is 17% (8.3% vs. 10%). Therefore, the margin of safety for the West Fork Big Blue River TMDL will be 20% for the reduced geometric mean and 17% for the percentage of values that exceed 400 #/100ml.

Desired Implementation Activities

In order to achieve the TMDL endpoint, the following section contains desired implementation activities. Where the implementation activity falls under the auspice of a regulatory program the appropriate actions should be taken in accordance with the rules and regulations adopted for that program. For non-regulatory activities, implementation will be voluntary but encouraged through a combination of information and education, the Section 319 nonpoint source program or other programs.

- Any limitation/reduction needed from a point source discharge will be implemented through the National Pollutant Discharge Elimination System permit program administered through the NDEQ's Municipal and Industrial Section.
- Evaluate municipal storm sewers and eliminate any cross connections. Should combined or sanitary sewer overflows be present, discharges from these source should be required to meet the regulations set for in EPA Combined Sewer Overflow Policy.
- Respond to and address any illicit discharge complaints.
- Require the remediation of identified failing septic systems or individual wastewater treatment facilities (lagoons).
- Title 130 – Rules and Regulations Pertaining to Livestock Waste Control requires controls facilities for livestock operations of three hundred animal unit or larger or where a discharge to waters of the state has been confirmed, regardless of the operation's size. For livestock operations less than three hundred animal units, the Department will determine whether or not a livestock operation has a high potential for discharge into waters of the State whereby after proper notification the livestock operation will be subject to the Livestock Waste Management Act. In waters where TMDLs are proposed or approved and operations that have the potential to contribute the Section 303(d) listed pollutant (e.g. fecal coliform, nutrients) exists, the Planning Unit will request the Agriculture Section review these facilities and take the appropriate actions in accordance with Title 130. A request will also be made to prioritize facilities within 1 linear mile of tributary streams.
- A biosolids management plan should be developed for the watershed. The plan will include the disposal and beneficial re-use of municipal biosolids, manure and septage; and should be developed by the personnel from the Department's Municipal and Industrial Section, Agriculture Section and Technical Assistance Unit. The plan should prescribe application timing, rates and practices in an effort to avoid an impact from these sources during the recreation season.
- Employ the use of soil erosion control practices such as; buffer strips along stream corridors, terraces and grassed waterways, in areas where biosolids, manure or septage are land applied.
- Nutrients and fecal coliform are transported with sediment during run-off events therefore, any practice or activity that will result in a reduction of soil erosion should aid in reducing fecal coliform bacteria delivery to waterbodies. For this reason, soil erosion reduction practices will be encouraged throughout the watershed.

- Restricting livestock access to surface waters (fencing, providing alternate water supplies) can be effective at reducing direct fecal coliform contributions. The Department supports and encourages this activity where feasible.

Successful implementation of this TMDL requires a cooperative effort be undertaken by many different local, state and federal agencies as well as private entities

Reasonable Assurances

Effective management of nonpoint source pollution in Nebraska necessarily requires a cooperative, unified and coordinated effort by many agencies and organizations, both public and private. Each organization is uniquely equipped to deliver specific services and assistance to the citizens of Nebraska to help reduce the effects of nonpoint source pollution on the State's water resources. Appendix A lists those entities that may potentially be included in the implementation process. These agencies have been identified as being responsible for program oversight or fund allocation that may be useful in addressing and reducing the fecal coliform levels in the West Fork Big Blue River. Participation will depend upon the agency/organization's program capabilities.

Monitoring

The Department's Water Quality Assessment and Monitoring Section has committed to develop monitoring plans and conduct the field activities based upon a rotating basin management scheme. With this plan, sampling is focused in two or three river basins each year with one of the goals being the collection of data that can be used for beneficial use assessment. Under the current approach, the West Fork Big Blue River will be sampled during 2002 and 2007.

As well, the Planning Unit will be requesting samples be obtained to support the TMDL program. It is anticipated the data to be collected will include an expanded sampling network within the basin to evaluate the distribution of the problem to potentially identify individual sources and flow event sampling to verify the conclusion of the previous data assessment. Also, if feasible the Department will utilize Microbial Source Tracking in order to identify down to the species level, the source of fecal coliform within the basin. Data from these collections will be used to evaluate the effectiveness of the TMDL and modifications, if appropriate will be made to the TMDL

Also, the Department is in the process of building an ambient stream monitoring network where fixed stations are sampled on a fixed frequency basis. The Planning unit will be providing input on the network in an effort to obtain information that can be used for TMDL development and evaluation.

Public Participation/Feedback

This TMDL was made available to the public on the Department's Internet site and the availability of the draft TMDL was announced through three newspapers; namely Lincoln Journal Star, York News-Times and the Hastings Tribune. The public notice/comment period was from June 17 through October 17, 2000. Additionally a copy of the draft TMDL were mailed to potential stakeholders. The Department also attended and made presentations at a combined Lancaster County, Seward County and Saline County Farm Bureaus meeting.

Comments received on the draft TMDLs and the Department's responses to are included in Attachment B.

References

1. EPA, 1997. Guidance For Data Quality Assessment – Data Quality Assessment Statistical Toolbox (DataQUEST), Office of Research and Development, Washington DC.

2. NDEQ, 1998. 1998 Nebraska Water Quality Report, Nebraska Department of Environmental Quality-Water Quality Division
3. NDEQ, 2000. Title 117 – Nebraska Surface Water Quality Standards, Nebraska Department of Environmental Quality – Water Quality Division, Lincoln, NE
4. NDEQ, 1993. Disinfection Policy and Implementation, Nebraska Department of Environmental Quality – Water Quality Division, Lincoln, NE.
5. Nebraska Natural Resources Commission, 1975. Big Blue Basin Water Quality Management Plan, Lincoln, NE.
6. Nebraska Natural Resources, 2000. NRC Databank, Lincoln, NE.

Appendix A – Federal, State Agency and Private Organizations Included in TMDL Implementation.

FEDERAL
- Bureau of Reclamation
- Environmental Protection Agency
- Fish and Wildlife Service
- Department of Agriculture - Farm Services Agency
- Department of Agriculture - Natural Resources Conservation Service

STATE
- Association of Resources Districts
- Department of Agriculture
- Department of Environmental Quality
- Department of Roads
- Department of Water Resources
- Department of Health and Human Services
- Environmental Trust
- Game and Parks Commission
- Natural Resources Commission
- University of Nebraska Institute of Agriculture and Natural Resources (IANR)
- UN-IANR: Agricultural Research Division
- UN-IANR: Cooperative Extension Division
- UN-IANR: Conservation and Survey Division
- UN-IANR: Nebraska Forest Service
- UN-IANR: Water Center and Environmental Programs

LOCAL
- Natural Resources Districts
- County Governments (Zoning Board)
- City/Village Governments

NON-GOVERNMENTAL ORGANIZATIONS
- Nebraska Wildlife Federation
- Audubon Society
- Pheasants Forever
- Nebraska Water Environment Association
- Nebraska Farm Bureau
- Nebraska Corn Growers Association, Wheat Growers, etc.
- Nebraska Cattlemen's Association, Pork Producers, etc
- Other specialty interest groups
- Local Associations (i.e. homeowners associations)